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**Material Crack Propagation**

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**Acknowledgement**

Mr John Gibson is a highly regarded educator and engineer. John taught Industrial Arts at a number of high schools before taking a position at Sydney Teachers’ College, then University of Sydney. He had an engineering education consultancy and has extensive experiencing working with NESA on Engineering Studies syllabus development and the HSC examination committee. The STEM Industry School Partnerships (SISP) Program asked John for his responses to the iTeachSTEM topic discussion questions. SISP is grateful to John for submitting these example discussion responses.

# Why is material crack analysis relevant?

Analysis for potential crack behaviour in a component can prevent catastrophic failures.

1. **Describe ways that crack propagation is studied.**

* materials, subject to cracking under applied loads, can be tested using a fatigue testing machine
* a prepared metal specimen is placed under cyclic load conditions and tested to failure
* the stress is measured; the number of cycles, before failure, are recorded
* data is presented on a Stress/Number of Cycles graph

1. **Describe methods to eliminate cracking.**

* crack energy occurs at, or near, the end of a crack. To relieve this stress, a common method is to drill a small hole at the end of the crack
* another method is to fasten a new plate over the extent of the crack to support the cracked material

1. **Identify crack failure types such as brittle material failure and, ductile material failure.**

* Brittle material failure can usually be identified as the sides of the crack will be rough/angular
* Ductile material failure can usually be identified as the area around the crack will show clear deformation (tearing)

1. **Define fatigue cracking and failure.**

* fatigue cracks are due, in part, to work hardening of the metal caused by continuous cyclic loading; the crack starts as a small defect on the surface
* a distinctive pattern appears as the metal rubs, not unlike waves washing up on a beach
* a point is reached where the remaining metal cannot support the applied loads, resulting in serious failure